KACHEMAK BAY RESEARCH RESERVE

MARINE-DERIVED NUTRIENTS

ISSUE:

Coastal ecosystems may be heavily dependent on returning salmon as a nutrient source. Each salmon can be thought of as a sack of fertilizer that is filled as the salmon grows in the ocean and is emptied in freshwater systems as the adults return, spawn, and decay. These marine-derived nutrients (MDN) sustain the productivity of freshwater stream and riparian ecosystems. However, we know little about the relative value of MDN compared to other nutrient and carbon sources (e.g., watershed-derived) in the Gulf of Alaska region.

OBJECTIVES:

The objectives of this study were to track and measure MDN effects in stream, riparian and nearshore environments, on the southern Kenai Peninsula, and to develop a water chemistry proxy for monitoring salmon returns. Our main hypotheses were (1) that stable isotope and fatty acid signatures in juvenile fish would reflect increasing MDN presence and effects along a gradient from headwaters to stream mouth in salmon-bearing streams; (2) that this effect would be greater in watersheds with low ambient nutrient concentrations than in watersheds with higher ambient nutrient concentrations; and (3) that salmon escapement can be estimated by measuring a suite of water chemistry components and salmon numbers.

METHOD:

We tested a variety of methods in different trophic levels at seasonal, watershed and regional scales in an attempt to determine the most reliable measures of MDN in stream ecosystems. Our results show that stable isotopes and fatty acids were both effective indicators of MDN assimilation in stream resident fishes. Fatty acids were most effective when quantified as ω3:ω6. Our results also show that underlying geology and isotopically heavy nutrient sources other than spawning salmon can affect how a watershed system responds to MDN subsidies, making it important to develop monitoring programs on a system by system basis.

HIGHLIGHTS

- MDN were incorporated into biota prior to seasonal salmon runs, suggesting sequestering or storage of MDN in the stream from the previous year.
- Biota from salmon spawning sites showed consistent enriched MDN values relative to sites with no salmon.
- Omega 3:omega (ω3:ω6) fatty acids appear to be a reliable indicator of MDN influence in resident stream fishes (Dolly Varden and sculpin).
- Results from nutrient proxy investigations revealed limited potential for development of a nutrient proxy for salmon escapement.

Stream macroinvertebrates (Limnephilid caddisflies) feed on a dead salmon head.

PARTNERS

- UNIVERSITY OF ALASKA ANCHORAGE
- UNIVERSITY OF ALASKA FAIRBANKS
- UNITED STATES GEOLOGICAL SURVEY

STATUS: COMPLETE

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